

## PATENT ABSTRACTS OF JAPAN

(11) Publication number : 11- 253504  
 (43) Date of publication of application : 21.09.1999

(51) Int.Cl.

**A61H 1/02**

(21) Application number : 10- 061681  
 (22) Date of filing : 12.03.1998

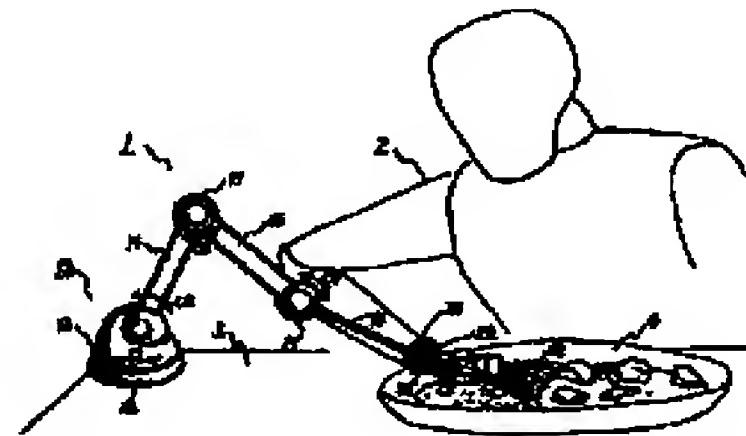
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## (54) UPPER LIMB MOTION ASSISTING DEVICE

## (57) Abstract:

**PROBLEM TO BE SOLVED:** To simplify the constitution, and effectively assist everyday life or the like such as a manual work by a method wherein at a free end of this assisting device, an appliance which is fitted on an upper limb of a person to be assisted, is provided, and the track of the free end is controlled based on force information of the person to be assisted, which is applied to the appliance, and the motion of the upper limb is assisted.

**SOLUTION:** The vector of a force from a person to be assisted is detected by a force sensor which is applied on an appliance 23, and the vector is read by a control part. The control part obtains the amount and the direction of the applied force by the force vector, and controls the track of a free end part 11 of a manipulator 1. That is, respective driving motors for respective joints 15, 17, 19 and 22 are controlled. Thus, the rotating amounts of respective joints 15, 17, 19 and 22 are controlled, and at the same time, the location of the free end part 11 with a fixed part 13 as a reference, based on the command values, is calculated. Thus, hand can be moved to a tableware 4, e.g. a spoon 20 or the like, and everyday life and a rehabilitation or the like can be effectively assisted.



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**CLAIMS****[Claim(s)]**

[Claim 1] An upper extremity movement auxiliary device having the free end section in which an appliance with which auxiliary personnel's upper extremity is equipped was provided, controlling an orbit of said free end section based on auxiliary personnel's power information applied to said appliance, and assisting operation of said upper extremity.

[Claim 2] An upper extremity movement auxiliary device which it has the following, and this control section moves said free end section in the power direction detected by said force sensor with movement magnitude according to a size of power of a test, and is characterized by assisting operation of said upper extremity.

A manipulator which has the free end section in which an appliance with which auxiliary personnel's upper extremity is equipped was provided and in which orbit control of this free end section is possible.

A force sensor which detects auxiliary personnel's force vector applied to said appliance.

A control section which controls the move direction and movement magnitude of said free end section according to a detection vector of this force sensor.

[Claim 3] The upper extremity movement auxiliary device according to claim 2, wherein auxiliary personnel's hand part or a wrist part is equipped with said appliance.

[Claim 4] The upper extremity movement auxiliary device according to claim 2 or 3 when said control section is changing [ auxiliary personnel's power direction added to said appliance ] with a cycle of low frequency, wherein it does not perform orbit control of said free end section according to a detection vector of said force sensor.

[Claim 5] The upper extremity movement auxiliary device according to any one of claims 2 to 4 when an electric power supply from a driving source is intercepted said manipulator, wherein it is formed movable with auxiliary personnel's power in which said free end section was added to said appliance.

[Claim 6] Have said manipulator at a tip of the free end section, and an attaching part holding an instrument for prescribed working said control section, The upper extremity movement auxiliary device according to any one of claims 2 to 5 characterized by controlling an orbit of said attaching part so that said instrument may serve as a proper posture regardless of a detection vector of said force sensor.

[Claim 7] The upper extremity movement auxiliary device according to claim 6, wherein it has the storage parts store which made information about a proper posture of said instrument memorize beforehand and said control section controls an orbit of said attaching part based on information memorized by this storage parts store.

[Claim 8] The upper extremity movement auxiliary device according to any one of claims 2 to 5, wherein said appliance is provided with an assisting mechanism part which assists a retention span of each finger of a hand of having been equipped with this appliance.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

#### [0001]

[Field of the Invention] This invention relates to the manual assistance of operation in everyday life, such as a physically handicapped person and elderly people, and the upper extremity movement auxiliary device used for a rehabilitation tee etc.

#### [0002]

[Description of the Prior Art] Although there are a wheelchair etc. conventionally as a device with which operation of physically handicapped elderly people, a physically handicapped person, etc. is assisted, this is only used for movement of the body, etc. and the function to assist operation of each portion of the body, i.e., hand and foot, and each of its joint portion cannot be given.

[0003] However, in the actual everyday life, the necessity of moving not only movement of the mere body but hand and foot, a joint, etc. arises mostly, and, for this reason, the device which makes it possible with an easy structure is demanded strongly.

[0004] Since a thing was not able to be grasped stably in the case of a handicapped person or the required old man of care and a hand was not able to be freely moved to it even if it is a case where easy handicraft, such as a meal, is performed especially, there was a problem referred to as that a care worker always does not assist handicraft, such as a meal.

[0005] In order to have in stock the tools required for rehabilitation in an ordinary home etc. where the tools and device which are used for a handicapped person's rehabilitation tee have many expensive things and to require a great amount of money, there was a problem which cannot fully perform the rehabilitation tee in a home conventionally.

#### [0006]

[Problem(s) to be Solved by the Invention] Then, in view of this point, it succeeds in SUBJECT of this invention, it can assist operation of the handicraft of the body by easy composition, and there is in providing the upper extremity movement auxiliary device by which it can profit effective in everyday life or a rehabilitation tee.

#### [0007]

[Means for Solving the Problem] This invention has the free end section in which an appliance with which auxiliary personnel's upper extremity is equipped was provided, It is characterized by controlling an orbit of said free end section based on auxiliary personnel's power information applied to said appliance, and assisting operation of said upper extremity, and specifically, A manipulator which has the free end section in which an appliance with which auxiliary personnel's upper extremity is equipped was provided and in which orbit control of this free end section is possible, A force sensor which detects auxiliary personnel's force vector applied to said appliance, According to a detection vector of this force sensor, it has a control section which controls the move direction and movement magnitude of said free end section, this control section moves said free end section in the power direction detected by said force sensor with movement magnitude according to a size of power of a test, and operation of said upper extremity is assisted.

[0008] By using this composition, it becomes possible to perform assistance according to power based on auxiliary personnel's volition in operation of auxiliary personnel's upper extremity, and to perform handicraft, such as a meal, by one auxiliary personnel.

[0009] Said appliance may be made composition with which auxiliary personnel's hand part or a wrist part is equipped. Thereby, a force vector based on auxiliary personnel's volition can be most

finely detected in an upper extremity.

[0010] Said control section may be made composition which does not perform orbit control of said free end section according to a detection vector of said force sensor when auxiliary personnel's power direction added to said appliance is changing with a cycle of low frequency. There is nothing that detected and mistook a force vector which does not have by this volition and a relation of the person himself/ herself generated by shaking of auxiliary personnel's hand etc. and that is done for power assistance.

[0011] And said manipulator may be made composition in which said free end section is established movable with auxiliary personnel's power applied to said appliance when an electric power supply from a driving source is intercepted. It is safe, without being able to move freely with auxiliary personnel's power in which a free end section was added to an appliance, and giving auxiliary personnel insecurity by electric power interception by this, when an electric power supply from a driving source is suddenly intercepted by interruption to service etc.

[0012] Said manipulator has an attaching part which holds an instrument for prescribed working at a tip of the free end section, and said control section may be made composition which controls an orbit of said attaching part so that said instrument may serve as a proper posture regardless of a detection vector of said force sensor. As a posture of instruments, such as a spoon, is held properly and progresses to auxiliary personnel's mouth by this, for example at the time of work of a meal etc., it can prevent dropping foodstuffs put on a crevice of a spoon as much as possible.

[0013] And it has the storage parts store which made information about a proper posture of said instrument memorize beforehand, and said control section may be made composition which controls an orbit of said attaching part based on information memorized by this storage parts store. Thereby, optimal control based on proper posture data of an instrument can be performed.

[0014] Said appliance may be made composition provided with an assisting mechanism part which assists a retention span of each finger of a hand of having been equipped with this appliance. Specified quantity assistance of the retention span for grasping an instrument oneself [auxiliary-personnel] is carried out by this, and it can grasp stably.

[0015]

[Embodiment of the Invention] Hereafter, the example of 1 embodiment of the upper extremity movement auxiliary device of this invention is explained based on the Drawings shown below.

[0016] The outline lineblock diagram of the upper extremity movement auxiliary device which drawing 1 shows one embodiment of this invention, the explanatory view explaining the state where auxiliary personnel were equipped with drawing 2 using the drawing 1 device, and drawing 3 show the outline control block diagram of the drawing 1 device, respectively.

[0017] In drawing 1 and drawing 2, 1 is a multi- flexibility manipulator which has the free end section 11 at the end, and the holding part 13 which has the adsorption part 12 which is fixable to arbitrary places is formed in the free end section 11 and the end of the opposite hand. The holding part 13 has the 2 flexibility C1 which makes the arm 14 pivotable at the circumference of an axis vertical to the level surface, and parallel, and the 1st joint part 15 that has C2. Between the arm 14 and the arm 16, the 2nd joint part 17 that has the flexibility C3 as for which the circumference of an axis parallel to the level surface makes the arm 16 pivotable is formed. Between the arm 16 and the arm 18, the 3rd joint part 19 that has the flexibility C4 as for which the circumference of an axis parallel to the level surface makes the arm 18 pivotable is formed similarly. The attaching part 21 which can hold the instruments 20, such as a spoon for a meal and a fork, enabling free attachment and detachment is formed in the free end section 11 side of the arm 18 via the 4th joint part 22. The 4th joint part 22 has the flexibility C5 as for which the circumference of an axis parallel to the level surface makes pivotable the instrument 20 with which the attaching part 21 is equipped, and it is set up so that a posture with the proper instrument 20 can be maintained by the rotation. For example, while putting foodstuffs on the crevice of the spoon 20 and carrying to the auxiliary personnel's 2 mouth, when using a spoon, as shown in a figure as the instrument 20, the posture will be maintained by rotation of the 4th joint part 22 so that the crevice may serve as a posture always parallel to the level surface. The spoon (instrument) 20 comprised elastomeric plastic material etc., and when putting the foodstuffs laid in the tableware 4 in the workspace 3 on the spoon 20, or when it puts the foodstuffs which appear in the spoon 20 in the auxiliary personnel's 2 mouth, elastic deformation is moderately possible for it, and it is come.

[0018] In the middle of the arm 18, the appliance 23 equipped with the auxiliary personnel's 2 wrist

part is formed. this appliance 23 receives the arm 18 -- the circumference of an axis parallel to the arm 18, and the circumference of a vertical axis -- a wrist part -- the specified quantity -- it is constituted so that it may be rockable. This is for making it like from power with a wrist part of the auxiliary personnel 2 at the time of the orbit control of the free end section 11 mentioned later impossible for. The force sensor 24 (not shown) which detects the vector of the power applied from the wrist part based on the auxiliary personnel's 2 volition is formed in the appliance 23.

[0019] Here, based on the instructions from the control section 31 mentioned later, respectively, the rotation is rotating the 1st joint part 15, the 2nd joint part 17, the 3rd joint part 19, and the 4th joint part 22 with the drive motor (not shown). And when the electric power supply from a driving source (not shown) to a drive motor is intercepted by interruption to service etc. The

electromagnetic clutch which is performing connection to the drive motor in each joint parts 15, 17, 19, and 22 serves as OFF, the connection can be cut automatically, and it can move now freely with the auxiliary personnel's 2 power in which the free end section 11 was added to the appliance 23. Here, connection to the drive motor in each joint parts 15, 17, 19, and 22 and cutting may be performed using electric viscous fluid and magnetic fluids other than an electromagnetic clutch.

[0020] So that a force vector without the volition and the relation of the person himself/herself generated by shaking of the auxiliary personnel's 2 hand etc. may not be detected, When the power direction detected with the force sensor 24 is changing with the cycle of the low frequency which is about several Hz, the control section 31 is controlled not to perform orbit control of the free end section 11 according to this detection vector.

[0021] Next, the activity is explained using the outline control block diagram of the upper extremity movement auxiliary device of the above-mentioned composition shown in drawing 3. In drawing 3, the control section 31 reads the force vector from the auxiliary personnel 2 detected by the force sensor 24 formed in the appliance 23 with a given period, A control signal is outputted to Motor Driver 32 which controls the drive motor in each joint parts 15, 17, 19, and 22 to that for making the orbit control of the free end section 11 of the manipulator 1 according to the size and direction of power which were added perform, The rotation of each joint parts 15, 17, 19, and 22 is controlled, and the position of the free end section 11 on the basis of the holding part 13 is computed based on the command value. 33 is a memory as a storage parts store the posture data for performing the proper attitude control according to the program for the orbit control of the free end section 11 and the kind of instrument 20, the position information on the workspace for a meal, etc. are remembered to be.

[0022] And in specifically putting the foodstuffs in the tableware 4 laid in the workspace 3 on the crevice of the instrument (spoon) 20 by the control section 31. The rotation of the 1st joint part 15, the 2nd joint part 17, and the 3rd joint part 19 can be controlled, and it can be made to move so that the free end section 11 can move in the power direction from the auxiliary personnel 2 detected by the force sensor 24 with the movement magnitude according to the size of the power, and the spoon 20 may take a desired orbit. While putting foodstuffs on the crevice of the spoon 20 and carrying to the auxiliary personnel's 2 mouth, the control section 31 controls rotation of the 4th joint part 22, and is maintaining the posture properly so that the crevice may serve as a posture always parallel to the level surface.

[0023] It can make it possible to assist operation of the auxiliary personnel's 2 upper extremity, and to perform handicraft, such as a meal, alone by this, and can use for everyday life, and a handicapped person's rehabilitation can also be performed easily.

[0024] Although the 1st example of an embodiment mentioned above explained the case where the holding part of the multi- flexibility manipulator 1 was fixed to the same table as the workspace 3, etc., The main part to which the holding part of not only this but the multi- flexibility manipulator 1 was attached especially enables it to move and fix independently, and it does not matter as composition which can fix and use a main part at a desired place.

[0025] Although the above- mentioned example of a 1st embodiment explained the composition which formed the attaching part 21 which can hold the instrument 20 enabling free attachment and detachment via the 4th joint part 22 in the free end section 11 side of the arm 18, other examples of an embodiment at the time of constituting so that it can hold directly by the auxiliary personnel's 2 hand part are explained below. Since it is the same as that of the example of a 1st embodiment mentioned above about the composition except the attaching part 21, the 4th joint part 22, and the appliance 23 which were provided in the free end section 11 side of the arm 18,

the explanation is omitted.

[0026] Drawing 4 is an explanatory view for explaining the 2nd example of an embodiment of this invention. In drawing 4, 41 is an appliance with which the auxiliary personnel's 2 hand part and wrist part are equipped, and the force sensor 24 (not shown) which detects the vector of the power applied from auxiliary personnel's wrist part like the above-mentioned example of a 1st embodiment is formed. To this appliance 41, as illustrated And the joint portion of auxiliary personnel's wrist part 42, The tube 45 divided and connected for every joint portion of each finger 44 of the hand part 43 is attached turnable, each finger 44 can be pushed on the common side of a hand by extension operation of the tube 45, and a finger can be grasped now. The tube 45 attached to each of this finger 44 is made to expand and contract, and the driving source 46 for assisting a predetermined retention span is formed. The oil pressure mechanism part which applies predetermined oil pressure to the tube 45 with which it filled up with the oil as this driving source 46 and to which an expanding action is made to perform is provided. And the 2nd force sensor 47 is formed in the tip part of each finger 44, and in the 2nd force sensor 47, when the power more than a predetermined size is added to each finger 47, assistance of whether each finger 44 closes to the common side of a hand or to open to the back side of a hand of operation is performed. However, when the opening of each finger 44 is more than the specified quantity at the time of movement of each finger 44 from a point of safety to the back side of a hand, tensile force works in the tube 45 by the driving source 46. Control of the driving source 46 is made to perform by the control section 31 mentioned above based on the detection result of the 2nd force sensor 47.

[0027] Thereby, when performing handicraft, specified quantity assistance can be carried out and the retention span at the time of grasping an instrument oneself [auxiliary-personnel] can be grasped stably. So that the force vector which does not have the volition and the relation of the person himself/herself generated by shaking of auxiliary personnel's hand etc. like the example of a 1st embodiment mentioned above may not be detected. When the power direction detected with the 2nd force sensor 47 is changing with the cycle of the low frequency which is about several Hz, the control section 31 is controlled not to perform expanding action control of the tube 45 according to this detection vector.

[0028] Next, the upper extremity movement auxiliary device 51 using the manipulator with which auxiliary personnel's upper-half-of-the-body portion was made to equip is explained. The outline line block diagram of the upper extremity movement auxiliary device which drawing 5 shows the 3rd example of an embodiment of this invention, and the explanatory view explaining the state where auxiliary personnel were equipped with drawing 6 using the drawing 5 device are shown, respectively.

[0029] In drawing 5 and drawing 6, 52 is a multi-flexibility manipulator which has the free end section 53 at the end, it is provided in the free end section 53 side, and the appliance 54 equipped with the auxiliary personnel's 61 wrist part 62 is formed. The end of the three link members 55, 56, and 57 is connected with this appliance 54 in the same part, It is attached so that the other end of these link members 55, 56, and 57 may have 3 flexibility rotatable in four-directions freedom at the predetermined place of the brace for fixation 58 with which the auxiliary personnel's 61 upper-half-of-the-body part can be equipped, respectively. The other end of the link member 55 is attached to the thorax portion of the brace for fixation 58, and, specifically, the other end of the link members 56 and 57 is attached to the head [of the right shoulder portion of the brace for fixation 58], and arm side, respectively. And as the drawing 6 arrow shows, each link members 55, 56, and 57 are constituted so that elasticity is possible. Each actuator 550,560,570 in which the drive motor (not shown) is built is formed in each link members 55, 56, and 57, each of that drive motor makes it rotate, and the link member is making it expand and contract. And as well as the example of an embodiment mentioned above when the electric power supply from a driving source (not shown) to a drive motor is interrupted by interruption to service etc. The electromagnetic clutch which is performing connection to the drive motor in each actuator 550,560,570 serves as OFF, the connection can be cut automatically, and it can move now freely with the auxiliary personnel's 61 power in which the free end section 53 was added to the appliance 54. Here, connection to the drive motor in each actuator 550,560,570 and cutting may be performed using electric viscous fluid and magnetic fluids other than an electromagnetic clutch.

[0030] The force sensor 24 (not shown) which detects the vector of the power applied to the appliance 54 from the wrist part 62 based on the auxiliary personnel's 61 volition is formed

similarly, Rotation of the drive motor in each actuator 55,56,570 according to this detection vector is controlled like the example of a 1st embodiment mentioned above, The free end section 53 can be moved in the power direction detected by the force sensor 24 with the movement magnitude according to the size of power of a test, and operation of an upper extremity can be assisted now.

[0031]It is possible for there to be no necessity that the holding part 13 of the multi- flexibility manipulator 1 makes it move, in each time of change of workspace, and to perform desired handicraft and rehabilitation anywhere like the example of a 1st and 2nd embodiment mentioned above, by the above composition, at it.

[0032]Although the case where carried out parallel links by the three link members 55, 56, and 57, and the multi- flexibility manipulator 52 was constituted from this example of a 3rd embodiment was explained, It does not matter as composition which makes the holding part fix to the brace for fixation 58 using the multi- flexibility manipulator for which it has the same many joint parts as the above - mentioned example of a 1st and 2nd embodiment. So that a force vector without the volition and the relation of the person himself/ herself generated by shaking of the auxiliary personnel's 61 hand etc. may not be detected, When the power direction detected with the force sensor 24 is changing with the cycle of the low frequency which is about several Hz, you may control not to perform orbit control of the free end section 53 according to this detection vector.

[0033]Explanation of the above- mentioned embodiment is for explaining this invention, and it should not be understood so that the invention of a description may be limited to Claims or the range may be reduced. As for each part composition of this invention, it is needless to say for various modification to be possible in technical scope given not only in the above- mentioned embodiment but Claims.

[0034]For example, although explanation of the above- mentioned example of a 1st embodiment explained the case where the multi- flexibility manipulator 1 which has many joint parts was used, as the example of a 3rd embodiment explained, the multi- flexibility manipulator realized according to the parallel link mechanism may be used.

[0035]

[Effect of the Invention]As above, according to this invention, it can make it possible to assist operation of auxiliary personnel's upper extremity and to perform handicraft, such as a meal, of the auxiliary personnel's themselves volition, and rehabilitation for effective support of operation or functional training can also be performed easily every day.

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## DESCRIPTION OF DRAWINGS

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### [Brief Description of the Drawings]

[Drawing 1]It is an outline lineblock diagram of the upper extremity movement auxiliary device in which the 1st example of an embodiment of this invention is shown.

[Drawing 2]It is an explanatory view explaining the state where auxiliary personnel were equipped using the drawing 1 device.

[Drawing 3]The outline control block diagram of the drawing 1 device is shown.

[Drawing 4]It is an explanatory view for explaining the 2nd example of an embodiment of this invention.

[Drawing 5]It is an outline lineblock diagram of the upper extremity movement auxiliary device in which the 3rd example of an embodiment of this invention is shown.

[Drawing 6]It is an explanatory view explaining the state where auxiliary personnel were equipped using the drawing 5 device.

### [Description of Notations]

1 and 52 Multi- flexibility manipulator

2 and 61 Auxiliary personnel

3 Works pace

4 Tableware

11 and 53 Free end section

13 Holding part

14, 16, and 18 Arm

15 The 1st joint part

17 The 2nd joint part

19 The 3rd joint part

20 Instrument

21 Attaching part

22 The 4th joint part

23, 41, and 54 Appliance

24 Force sensor

31 Control section

32 Motor Driver

33 Memory (storage parts store)

55, 56, 57 link members

58 Brace for fixation

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[Translation done.]

(19)日本国特許庁 (JP)

(12) 公開特許公報 (A)

(11)特許出願公開番号

特開平11-253504

(43)公開日 平成11年(1999)9月21日

(51)Int.Cl.<sup>6</sup>

A 61 H 1/02

識別記号

F I

A 61 H 1/02

K

審査請求 未請求 請求項の数8 O.L. (全8頁)

(21)出願番号

特願平10-61681

(22)出願日

平成10年(1998)3月12日

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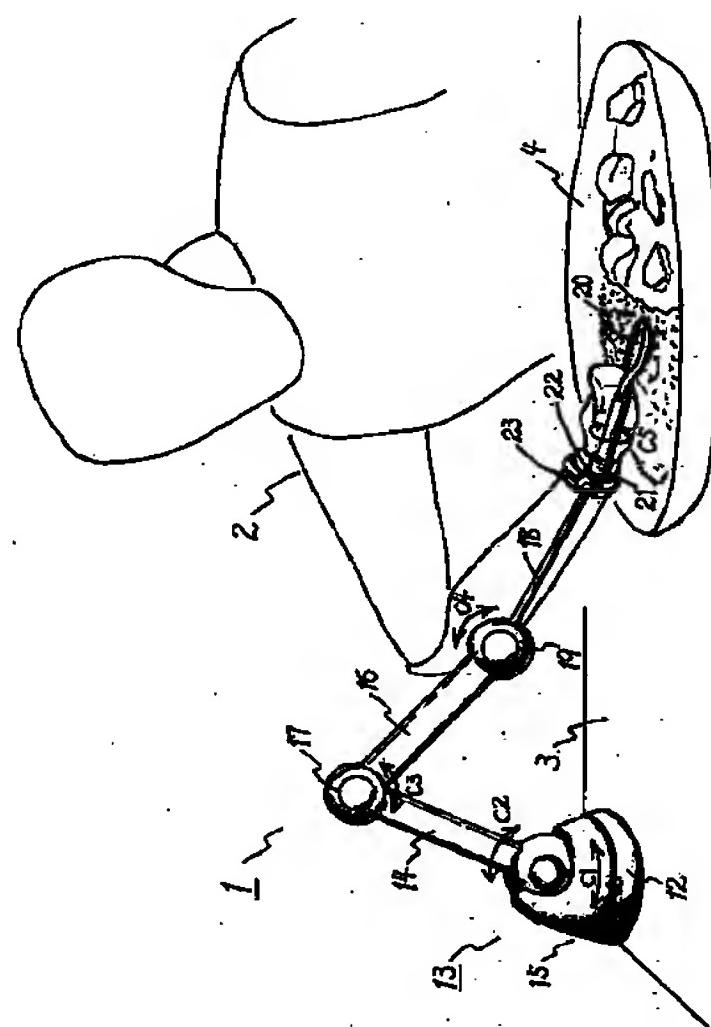
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(54)【発明の名称】 上肢動作補助装置

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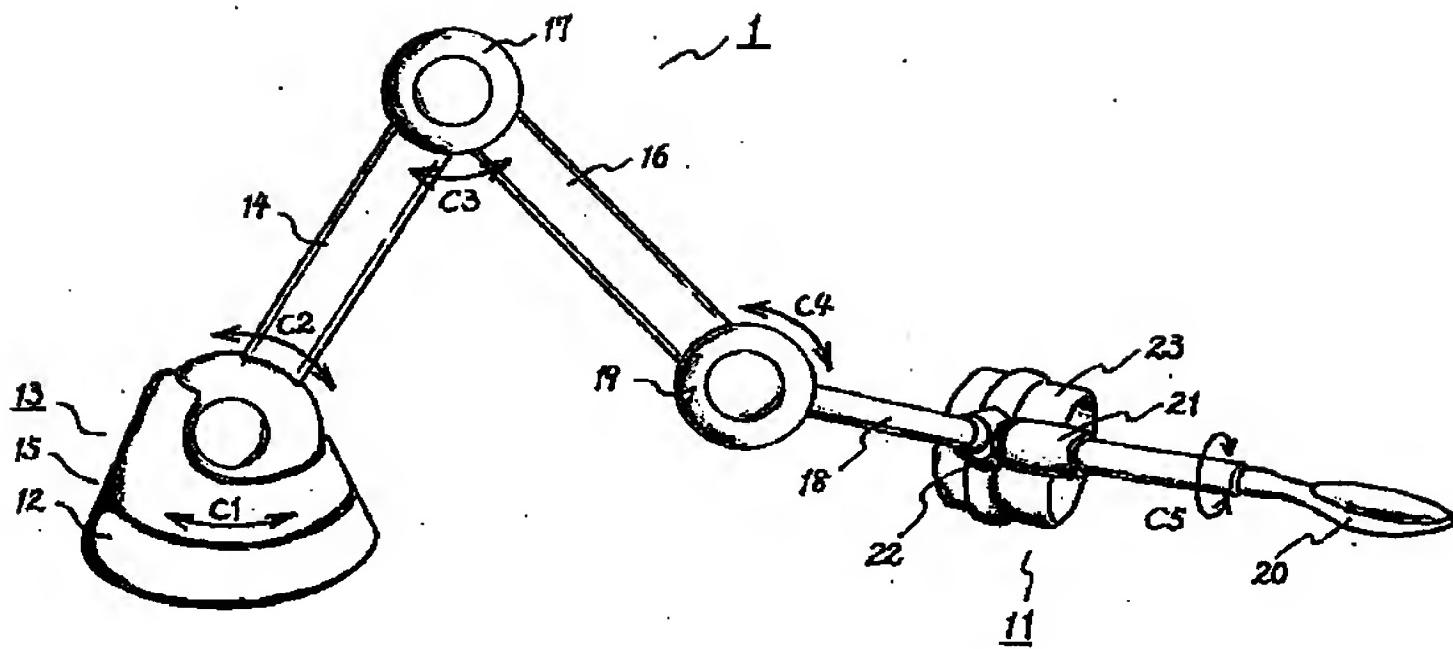




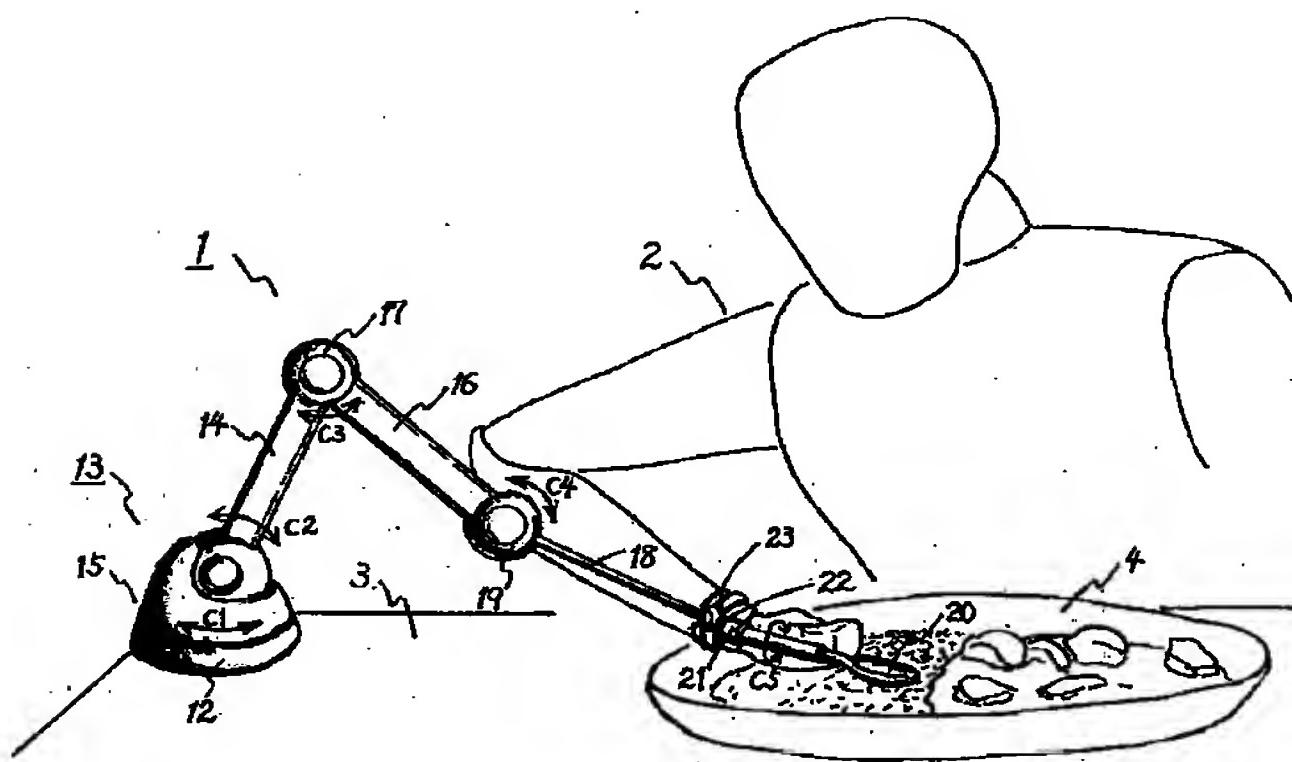
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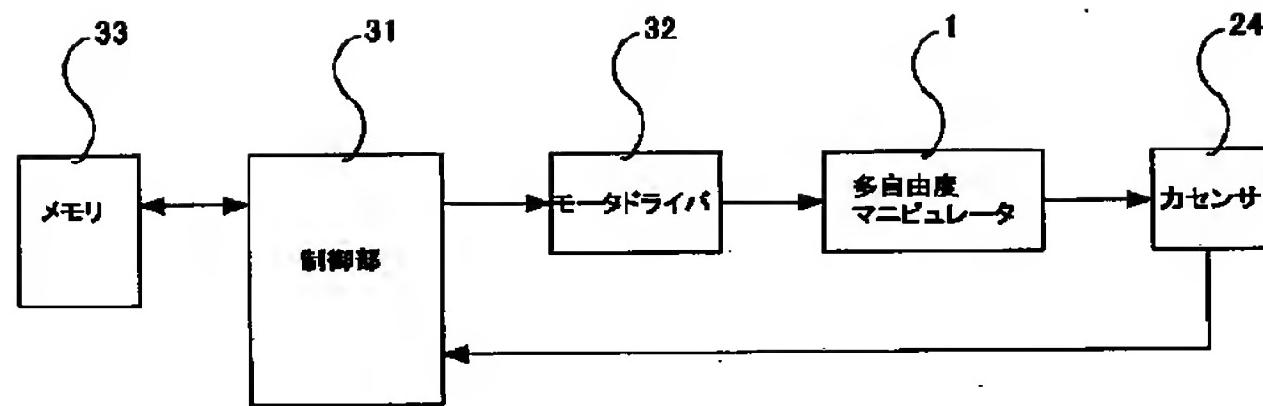
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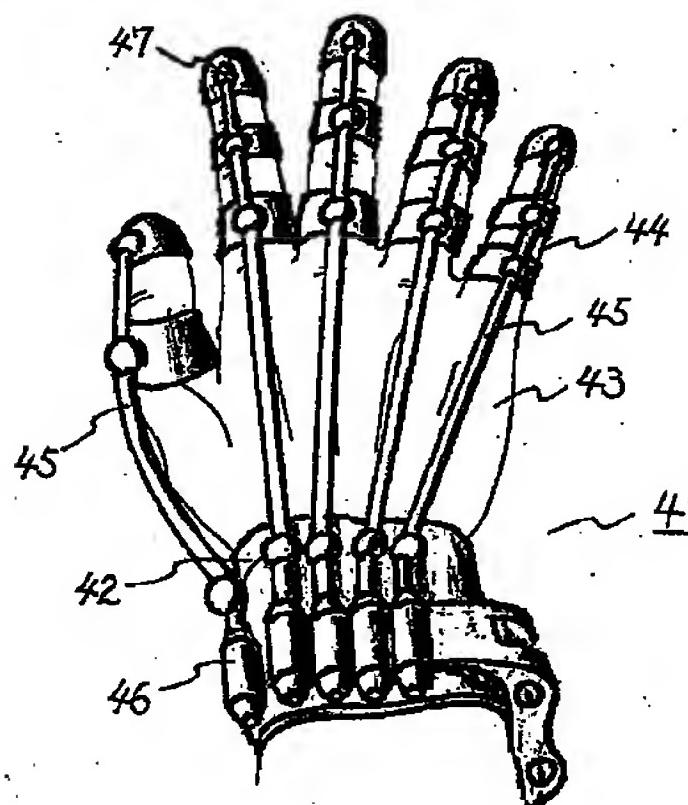
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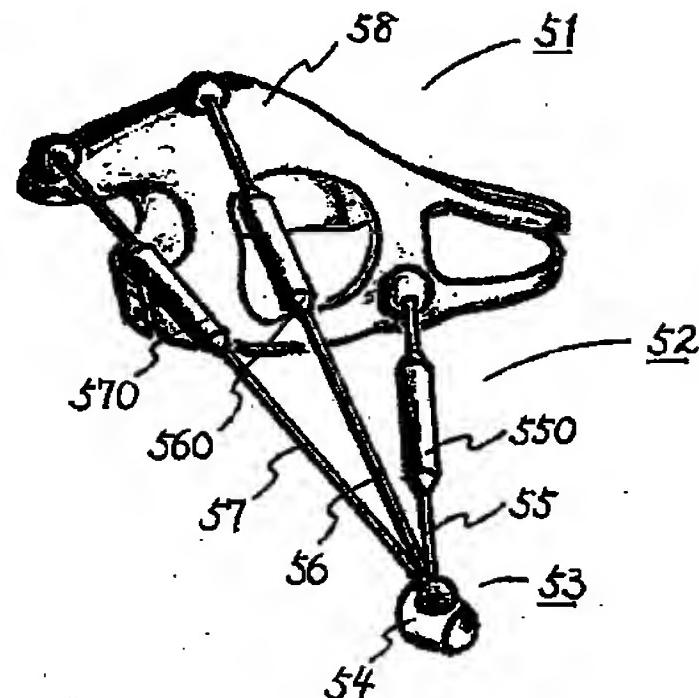
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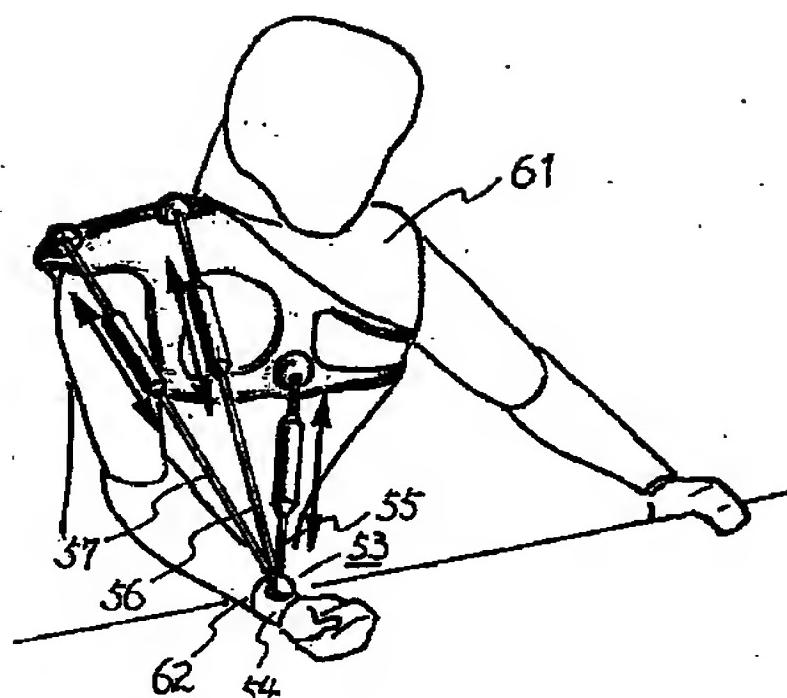
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